Australian party, namely, Messrs. Baracchi, Cooke, Dodwell, Kenney, and Beattie, and Mr. Short for Worthington's party. This is the last post until after the eclipse. We will do our best to keep the flag flying on that eventful day, but we must have a clear sky.

W. J. S. LOCKYER.

N.B.—The photographs accompanying this letter were all taken (with one exception) by Mr. Winklemann. They were printed by a bluejacket on board H.M.S. *Encounter*, as conditions were not favourable for the process ashore. This bluejacket is a volunteer for our photographic department, and a very valuable one. W. J. S. L.

PHYSIOGRAPHIC STUDIES IN THE FRENCH ALPS.

THE former of the two memoirs included in the publication before us is a report by MM. Flusin and Bernard upon an apparatus for boring into a glacier, devised by MM. Hess and Blümcke, the working of which they had studied on the Hintereisferner in the Austrian Tirol. As the scientific interest of this is at present more indirect than direct, we may pass on to the second memoir, "Etudes Glaciaires Géographiques et Botaniques dans le Massif des Grandes Rousses," by MM. Flusin, Jacob, and Offner.

The Grandes Rousses is a rather lofty and insulated range in the French Alps, which rises on the right bank of the Romanche, roughly north-east of Bourg d'Oisans. On its jagged crest, which runs approximately from N.N.E. to S.S.W., two peaks, though some distance apart, attain the same altitude—11,395 feet. Its western side descends more abruptly than the eastern, so the glaciers on the former are shorter and steeper than on the other. It is an island ridge of crystalline rock—granites more or less gneissoid, and schists—rising from a hilly district of Lower Mesozoic (chiefly Liassic) rocks, mainly, no doubt, a result of the second of the two great folding processes which have given birth to the Alpine chain.

First in order, to the west of the watershed between France and Italy, is the great mass of crystalline peaks which rise around the headwaters of the Vénéon—two of them, the Ecrins and Meije, exceeding 13,000 feet in height—and are linked by the Col du Lautaret to the mountains south of the Arc. Farther west is the range of the Grandes Rousses, and still farther in that direction, separated by another syncline of Mesozoic rock, comes that of the Belledonne, the highest peak on which attains 9781 feet. The Ecrins *massif* is probably an extension (though perhaps not a simple one) of the Mont Blanc axis; the Grandes Rousses and the Belledonne, a prolongation of that of the Arguilles Rouges, which has either bifurcated or raised up another earth-wave in front. But the Grandes Rousses *massif* affords evidence of a much more ancient system of disturbances, for two strips of Carboniferous rocks (as may be seen in the valley of the Romanche) are sharply infolded in the crystalline series—just as occurs in the valley of the Rhone and on the way from Vernayaz to the Tête Noire. The author attributes this folding to the Hercynian movements, though its strike is much more nearly north and south than east and west. It was, at any rate, succeeded by enormous denudation, for in this part of the Alps the base of the Mesozoic series may be seen resting on the denuded edges of these huge folds.

The report includes a study of the Alpine plants in the three regions or stages into which the range may be divided, and a very full account of the snowfields and glaciers. The snow-line, of course, varies in different localities, but the authors take 8720 feet as an average, which very nearly coincides with the limit of the *névé*, that is, where ablation balances accumulation, or expenditure just exhausts income in the matter of snow. This limit, they point out, rises as the altitude of a group increases, being about 650 feet higher in the Grandes Rousses than in the Belledonne, while in the eastern *massif* it overtops the former by 400 or 500 feet, a result which seems to call for explanation. Particulars also of the retreat of the glaciers are given, with maps and some interesting photographs; in short, the memoir is a most elaborate one, though we cannot forbear remarking that if a similar exhaustive treatment is applied to other parts of the Alps—and the practice seems to be growing—conscientious students will before long often have to choose between hours in a library and work in the field.

T. G. B.

[1] Ministère de l'Agriculture — Direction de L'Hydraulique et de Améliorations Agricoles—Service d'Etudes des Grandes Forces Hydrauliques (Région des Alpes)—Études Glaciologiques. Tirol Autrichien. Massif des Grandes Rousses. Pp. vi+112 + ix plates + ix panorama views (1909).

THE MOVEMENT OF SUBSOIL WATER.[1]

IN all densely populated areas the water supply is a matter of primary importance, especially where the rainfall is scanty, and where a large proportion of the supply is derived from shallow wells. Dr. W. F. Smeeth, of the Geological Department of Mysore, has prepared a report dealing with this subject, which is based upon observations made during the year 1909, so that it provides rather a basis for further study than a complete discussion of the subject. The Mysore plateau extends over some 29,400 square miles, and is composed almost entirely of gneisses, granites, and crystalline schists, which are more or less decomposed to a depth of from 50 to in some places as much as 100 feet; the upper 50 feet of this forms a reservoir which is fed by the rainfall, and will hold a quantity of water varying with the porosity of the materials, and from it the wells derive their supply. On account of the seasonal character of the rainfall the level of the water-table varies considerably, and from various considerations the author takes a zone of intermittent saturation having a mean depth of 10 feet, and an average porosity of 12 per cent., as representing the average conditions which occur.

The rainfall varies greatly, from 73·21 inches in the west to 21·27 inches in the east of the area, and from the average variation of the water-level in wells, compared with a ground water supply which is taken as equal to 10 per cent. of the variation in the water level in each district, a "percolation factor" is obtained. No river discharges are included, nor is evaporation determined in order to obtain an independent value of the amount accounted for by percolation, which by the method employed is given as from 19·9 to 66·7 per cent. of the average rainfall. The rainfall also differs considerably in type in different portions of the area, having a strongly marked maximum in July due to the south-west monsoon in the west, while in the east the rainfall of the north-east monsoon in September and October is more important.

Observations were collected so far as possible from all villages, and 2563 wells were recorded from which fairly representative deductions for the year under investigation were possible. The mean depth of the water from the surface varied from about 38 to 4 feet, the mean values for maximum and minimum depths being 30 and 18, while the mean variation in the course of the year was 12·4 feet, and 37·5 per cent. of the wells were reported as drying up during the year. The variations of level ranged from an average of 15·3 feet for shallow wells in which the minimum depth to water-level was under 10 feet, to 8·2 feet in those where it was over 40 feet. Details of the water met with in the Mysore mines is included, but not much is deducible from such information at present. A series of diagrams show the position of the maximum and minimum water-levels in the village wells observed, and it is clear that a large number of them do not reach the depressed water-table of the dry season, since the conditions are not realised by the well owners. Deeper and fewer wells are recommended with pumping where necessary, and a systematic distribution of the permanent supply so obtained. Further investigation is recommended for the seasonal variation of water-level in different districts has not been considered. While diagrams are abundant, maps of the region, whether topographical, orographical, or showing the distribution of the rainfall, are conspicuous by their absence, and render a satisfactory study of the report difficult.

Although the Nile and its system of canals provide most

[1] "Notes on the Underground Water Resources in Mysoer." By Dr. W. F. Smeeth. Pp. 69, plates 1–69. (Government Press, 1911.)

of the water needed by the population of Egypt, nevertheless many questions connected with the increase of population in towns and with intensive cultivation have lately directed attention to the position and the movements of the water-table in the alluvial plain of the Lower Nile. After some preliminary work in previous years, a more systematic investigation was started in Upper Egypt from Aswan to Cairo, in 1907–8, to obtain definite information. This has now been published in the form of a departmental paper by Mr. H. T. Ferrar, of the Geological Survey of Egypt.[1] Observations were made at 239 wells which were visited, and the water-level recorded an average of eight times during the twelve months from one flood of the river to the next; since no rainfall occurs to complicate the conditions, these data were sufficient to define with adequate accuracy the range and movement of the water-table in that year. The rock trough in which the Nile flows is largely filled by pleistocene sands and gravels, over which the alluvial deposits have been laid down, and into these the wells from which water-wheels lift water are usually dug down through the alluvium and into the underlying sands; from these wells most of the observations were taken. At many points the Nile itself has cut into these sandy diluvial deposits, or flows against them at the margin of the valley, so that the river water is in communication with both deposits. A series of diagrams show the variation of the water-level in each well throughout the year, and also the position of the water-table for each month at fifteen different points of the river. Slight differences due to variations in porosity, &c., are to be seen, but the whole gives a very clear picture of the movement of subsoil water. The lines for September and October show its rapid rise, after which the fall commences, being greatest between December and January and afterwards decreasing. In these later months there is often a slope towards the river, and an appreciable amount of stored water is then returned from the flood plain to the river. It would have been preferable if the observed values had been indicated on the diagrams and the depths of the wells drawn, as the curves do not show to what extent they are controlled by data without reference to the printed tables.

In subsequent chapters an attempt is made to compute the quantity of water which the alluvial plain can hold, 60 per cent. by volume being taken as the water absorbed by the soil, but measured discharges of the river and canals are not utilised, and the values obtained cannot be regarded as more than rough approximations. Data for determining the direction of movement are scanty; near the river, results vary greatly within short distances, and in villages any use of colouring matter in such investigations would arouse much hostility. A large amount of valuable data has been collected, which greatly increases our knowledge of the water in the Nile valley, and must be of the greatest value for agriculture and for public health. The wells of the flood-plain are grouped into those of the river margin which are immediately affected by its changes of level, those of the plain which have an annual rise and fall about a month and a half after that of the river, and those close to the desert margin where the range is comparatively small. Further investigation on the same lines has been carried on since in the delta, which will be published in due course, forming a study of much value which, it is to be hoped, will be continued in the future.

[1] "The Movements of the Subsoil Water in Upper Egypt." By H. T. Ferrar. (Cairo: Survey Dept. Paper No. 19, 1911.)

THE ROYAL OBSERVATORY, GREENWICH.

MR. DYSON'S first report—as Astronomer Royal—was read at the annual meeting of the Board of Visitors held at Greenwich on June 2, and covers the year ended May 10. Below we give a brief summary.

The transit circle was employed for the usual observations and for the observation of stars of magnitude 9·0 and brighter between +24° and +32° north declination. The latter research, commenced in 1906 with the intention of securing five observations of each star, includes some 12,000 stars, and about 48 per cent. of the observations were completed at the date of report.

From the transit-circle and altazimuth observations of the moon's limb and Mösting A, made during 1909, the mean error of the moon's tabular place was found to be −0·423s. in R.A. and −0·53″ in N.P.D.; from ninety-eight observations with the transit-circle, the mean error in R.A., for 1910, was found to be −0·543s.

A new mercury trough has been added to the altazimuth. It is carried on iron rails quite isolated from the floor, and the steadiness of the star images has become greatly improved.

Values for the moon's parallax have been obtained from the Cape-Greenwich observations of Mösting A, made during 1905–10, and the probable error of the result, so far as it is independent of the earth's ellipticity, is ±0·06″. For values of $1/e$ ranging from 293 to 300, the correction to Hansen's value of the parallax ranges from +0·53″ to +0·12″; the combined results give +0·44″ as the correction and 294·5 as the value of $1/e$.

Bimonthly investigations of the R–D discordance revealed a nearly constant discordance, amounting to 1·14″, in the yearly mean, which changes sign when the instrument is reversed, and although the object-glass has been remounted, the cause of this has not yet been discovered.

The mean error in R.A. of the moon's tabular place for 1910 is −0·59s. from meridian observations of the limb and −0·55s. from those of Mösting A.

The reflex zenith tube observations for 1906–9, discussed by Mr. Eddington, give results in fair accordance, on the whole, with those published by Dr. Albrecht for the International Latitude Service.

About 600 double-star observations were made with the 28-inch refractor, including observations of 110 pairs under 0·5″ separation and 153 pairs between 0·5″ and 1·0″.

In the 30-inch Thompson equatorial the mirror, last silvered in February, 1910, is still in good condition owing to the cover having been made air-tight by a band of pure rubber. This instrument was employed in photographing Saturn and its ninth satellite, comets 1909*c* and 1910*b* and *e*, and some of Herschel's nebulæ, the latter for identification and position determination.

The 26-inch refractor was chiefly employed in the photographic determination of the parallaxes of stars in the Greenwich astrographic zone, Kapteyn's method of exposures on the same plate at intervals of six months being followed.

As the southern declination of Jupiter made observations at Greenwich impossible, the director of the Helwan Observatory undertook to continue the observations of J viii, and eight photographs, taken on eight nights, have already been received at Greenwich for measurement. Approximate measures of the first two photographs of the satellite indicate that the Cowell-Crommelin ephemeris is only 20″ in error.

Since November, the Greenwich astrographic telescope has been employed in the photographic determination of the magnitudes of stars given in the two published volumes of the Greenwich zones, Pickering's plan of polar sequences being employed.

An interesting investigation now being carried out at the observatory is the enumeration of the stars of different magnitudes on the photographs of the whole sky taken by Mr. Franklin-Adams, who is bearing the cost. Twenty-six plates, covering the sky between the North Pole and +53°, have been dealt with, and 42,284 stars counted. The greatest number counted on any one plate (in twenty-five 20′ squares) was 5138, the least 301.

The Dallmeyer photoheliograph is now housed in the dome of the old altazimuth, where one quarter of the original dome was cut away and a corresponding sector fixed permanently in the north, so that the large dome-aperture thus secured is easily closed by bringing it under the fixed sector. For 1910 the solar photograph record is complete, the ninety gaps in the combined Greenwich and Cape series having been filled by photographs received from the Dehra Dûn and Kodaikânal observatories in India. Since the beginning of May, one of the photoheliograph observers has attended from 7 to 9 a.m., thus adding two hours to the period of observation, and also securing better results.

The mean daily spotted area of the sun's disc in 1910 was less than half that of 1909, and during the five months ended March 31, 1911, the disc was free from spots on sixty-seven days. During the rapidly approaching minimum the direction of the sun's axis is to be determined